

**CPC****COOPERATIVE PATENT CLASSIFICATION****F01N**

**GAS-FLOW SILENCERS OR EXHAUST APPARATUS FOR MACHINES OR ENGINES IN GENERAL; GAS-FLOW SILENCERS OR EXHAUST APPARATUS FOR INTERNAL COMBUSTION ENGINES** ({ evacuation of fumes from the area where they are produced [B08B 15/00](#); arrangement of exhaust or silencing apparatus on percussive tools [B25D 17/12](#)}; arrangements in connection with gas exhaust of propulsion units in vehicles [B60K 13/00](#), { on ships or other waterborne vessels [B63H 21/32](#), on aircraft [B64D 33/04](#); arrangement of exhaust or silencing apparatus on firearms [F41A 21/30](#); ground installations for reducing aircraft engine or jet noise [B64F 1/26](#); silencers specially adapted for steam engines [F01B 31/16](#); air-intake silencers for gas turbine or jet propulsion plants [F02C 7/045](#); jet pipe or nozzles for jet propulsion plants [F02K](#)}; combustion-air intake silencers specially adapted for, or arranged on, internal-combustion engines [F02M 35/00](#); { combating noise or silencing in positive displacement machines or pumps [F04B 39/0027](#), in rotary-piston machines or pumps [F04C 29/06](#), in non-positive displacement pumps [F04D 29/66](#); means in valves for absorbing noise [F16K 47/02](#); noise absorbers in pipe system [F16L 55/02](#); conducting smoke or fumes from various locations to the outside [F23J 11/00](#); means for preventing or suppressing noise in air-conditioning or ventilation systems [F24F 13/24](#)}; protecting against, or damping, noise in general [G10K 11/16](#))

**NOTE**

Attention is drawn to the notes preceding Class F01, especially as regards Note 2(b).

**F01N 1/00**

**Silencing apparatus characterised by method of silencing** {by cooling [F01N 3/02](#); using liquids [F01N 3/04](#)}

## F01N 1/003

. {by using dead chambers communicating with gas flow passages (resonance chambers [F01N 1/02](#); chambers containing sound-absorbing materials [F01N 1/24](#))}

## F01N 1/006

.. { comprising at least one perforated tube extending from inlet to outlet of the silencer}

## F01N 1/02

. by using resonance

## F01N 1/023

.. { Helmholtz resonators}

## F01N 1/026

.. { Annular resonance chambers arranged concentrically to an exhaust passage and communicating with it, e.g. via at least one opening in the exhaust passage}

## F01N 1/04

.. having sound-absorbing materials in resonance chambers

## F01N 1/06

. by using interference effect

## F01N 1/065

.. {by using an active noise source, e.g. speakers}

## F01N 1/08

. by reducing exhaust energy by throttling or whirling

## F01N 1/081

.. {by passing the gases through a mass of particles}

- F01N 1/082 .. {the gases passing through porous members ([F01N 1/081](#) takes precedence)}
- F01N 1/083 .. {using transversal baffles defining a tortuous path for the gases or successively throttling gas flow}
- F01N 1/084 .. {the gases flowing through the silencer two or more times longitudinally in opposite directions, e.g. using parallel or concentric tubes}
- F01N 1/085 .. {using a central core throttling gas passage}
- F01N 1/086 .. {having means to impart whirling motion to the gases (with helically or spirally shaped channels [F01N 1/12](#))}
- F01N 1/087 ... {using tangential inlets into a circular chamber}
- F01N 1/088 ... {using vanes arranged on gas flow path or gas flow tubes with tangentially directed apertures}
- F01N 1/089 .. {using two or more expansion chambers in series ([F01N 1/083](#), [F01N 1/084](#), [F01N 1/086](#) take precedence)}
- F01N 1/10 .. in combination with sound-absorbing materials ([F01N 1/125](#) takes precedence)
- F01N 1/12 .. using spirally or helically shaped channels (cyclones [B04C](#))
- F01N 1/125 ... {in combination with sound-absorbing materials}
- F01N 1/14 . by adding air to exhaust gases {(in tailpipes **F01N 7/08B**, **F01N 7/20**)}
- F01N 1/16 . by using movable parts
- F01N 1/161 .. { for adjusting resonance or dead chambers or passages to resonance or dead chambers}
- F01N 1/163 ... { by means of valves}
- F01N 1/165 .. {for adjusting flow area}
- F01N 1/166 .. {for changing gas flow path through the silencer or for adjusting the dimensions of a chamber or a pipe ([F01N 1/165](#) takes precedence)}
- F01N 1/168 .. { for controlling or modifying silencing characteristics only}
- F01N 1/18 .. having rotary movement
- F01N 1/20 .. having oscillating or vibrating movement {the parts being resilient walls [F01N 1/22](#)}
- F01N 1/22 .. the parts being resilient walls
- F01N 1/24 . by using sound-absorbing materials ([F01N 1/04](#), [F01N 1/06](#), [F01N 1/10](#), [F01N 1/14](#), [F01N 1/16](#) take precedence)
- F01N 3/00** **Exhaust or silencing apparatus having means for purifying, rendering innocuous, or otherwise treating exhaust** (electric control [F01N 9/00](#); monitoring or diagnostic devices for exhaust-gas treatment apparatus [F01N 11/00](#); {collecting or removing exhaust gases of vehicle engines in workshops [B08B 15/00](#), on highways [E01C 1/005](#)})
- F01N 3/005 . { for draining or otherwise eliminating condensates or moisture accumulating in the apparatus ([F01N 3/02](#) takes precedence)} [c0809]
- F01N 3/01 . by means of electric or electrostatic separators
- F01N 3/02 . for cooling, or for removing solid constituents of, exhaust (by means of electric or electrostatic separators [F01N 3/01](#); {mixing air with exhaust in tailpipes **F01N 7/08B**, **F01N 7/20**})
- F01N 3/0205 .. { using heat exchangers}

- F01N 3/021 .. by means of filters
- F01N 3/0211 ... {Arrangements for mounting filtering elements in housing, e.g. with means for compensating thermal expansion or vibration}
- F01N 3/0212 ... {with one or more perforated tubes surrounded by filtering material, e.g. filter candles}
- F01N 3/0214 ... {with filters comprising movable parts, e.g. rotating filters}
- F01N 3/0215 ... { the filtering elements having the form of disks or plates}
- F01N 3/0217 ... { the filtering elements having the form of hollow cylindrical bodies}
- F01N 3/0218 ... { the filtering elements being made from spirally-wound filtering material}
- F01N 3/022 ... characterised by specially adapted filtering structure, e.g. honeycomb, mesh or fibrous
  - F01N 3/0222 .... {the structure being monolithic, e.g. honeycombs}
  - F01N 3/0224 .... {the structure being granular}
  - F01N 3/0226 .... {the structure being fibrous}
  - F01N 3/0228 .... {the structure being made of foamed rubber or plastics}
- F01N 3/023 ... using means for regenerating the filters, e.g. by burning trapped particles (by electrically controlling the supply of combustible mixture or its constituents only [F02D 41/0235](#))
  - F01N 3/0231 .... {using special exhaust apparatus upstream of the filter for producing nitrogen dioxide, e.g. for continuous filter regeneration systems (CRT)}
  - F01N 3/0232 .... { removing incombustible material from a particle filter, e.g. ash}
  - F01N 3/0233 .... { periodically cleaning filter by blowing a gas through the filter in a direction opposite to exhaust flow, e.g. exposing filter to engine air intake}
  - F01N 3/0234 .... { using heat exchange means in the exhaust line}
  - F01N 3/0235 .... { using exhaust gas throttling means}
  - F01N 3/0236 .... { using turbine waste gate valve}
  - F01N 3/0237 .... { for regenerating ex situ}
  - F01N 3/0238 .... { for regenerating during engine standstill}
- F01N 3/025 ... using fuel burner or by adding fuel to exhaust
  - F01N 3/0253 ..... {adding fuel to exhaust gases}
  - F01N 3/0256 ..... {the fuel being ignited by electrical means}
- F01N 3/027 ... using electric or magnetic heating means
  - F01N 3/0275 ..... {using electric discharge means}
- F01N 3/028 ..... using microwaves
- F01N 3/029 ... by adding non-fuel substances to exhaust
  - F01N 3/0293 ..... { injecting substances in exhaust stream}
  - F01N 3/0296 ..... { having means for preheating additional substances}
- F01N 3/031 ... having means for by-passing filters, e.g. when clogged or during cold engine start
  - F01N 3/032 .... during filter regeneration only
  - F01N 3/033 ... in combination with other devices {with adsorbents or absorbents [F01N 3/0821](#)}
  - F01N 3/0335 .... {with exhaust silencers in a single housing}
  - F01N 3/035 .... with catalytic reactors, { e.g. catalysed diesel particulate filters }
- F01N 3/037 .. by means of inertial or centrifugal separators, e.g. of cyclone type, optionally

- combined or associated with agglomerators
- F01N 3/038 . . by means of perforated plates defining expansion chambers associated with condensation and collection chambers, e.g. for adiabatic expansion of gases and subsequent collection of condensed liquids
- F01N 3/04 . . using liquids
- F01N 3/043 . . . {without contact between liquid and exhaust gases}
- F01N 3/046 . . . . {Exhaust manifolds with cooling jacket}
- F01N 3/05 . . by means of air, e.g. by mixing exhaust with air (silencers working by addition of air to exhaust [F01N 1/14](#); arrangements for the supply of additional air for the thermal or catalytic conversion of noxious components of exhaust [F01N 3/30](#); {in tailpipes **F01N 7/08B**})
- F01N 3/055 . . . { without contact between air and exhaust gases}
- F01N 3/06 . for extinguishing sparks
- F01N 3/08 . for rendering innocuous (using electric or electrostatic separators [F01N 3/01](#); chemical aspects [B01D 53/92](#))
- F01N 3/0807 . . {by using absorbents or adsorbents}
- F01N 3/0814 . . . { combined with catalytic converters, e.g. NOx absorption/storage reduction catalysts}
- F01N 3/0821 . . . { combined with particulate filters (catalysed diesel particulate filters [F01N 3/035](#))}
- F01N 3/0828 . . . { characterised by the absorbed or adsorbed substances}
- F01N 3/0835 . . . . { Hydrocarbons}
- F01N 3/0842 . . . . { Nitrogen oxides}
- F01N 3/085 . . . . { Sulfur or sulfur oxides}
- F01N 3/0857 . . . . { Carbon oxides}
- F01N 3/0864 . . . . { Oxygen}
- F01N 3/0871 . . . {Regulation of absorbents or adsorbents, e.g. purging (by electrically controlling the supply of combustible mixture or its constituents only [F02D 41/0235](#))}
- F01N 3/0878 . . . . {Bypassing absorbents or adsorbents}
- F01N 3/0885 . . . . {Regeneration of deteriorated absorbents or adsorbents, e.g. desulfurization of NOx traps}
- F01N 3/0892 . . {Electric or magnetic treatment, e.g. dissociation of noxious components (electric filters [F01N 3/01](#); regeneration of exhaust filters [F01N 3/023](#); heating catalytic converters [F01N 3/2006](#))}
- F01N 3/10 . . by thermal or catalytic conversion of noxious components of exhaust (by using other chemical processes, chemical aspects of catalytic conversion, e.g. using specified catalysts, [B01D 53/34](#))

**WARNING**

[F01N 3/10](#) are not complete pending a reorganisation

- F01N 3/101 . . . { Three-way catalysts}
- F01N 3/103 . . . { Oxidation catalysts for HC and CO only}
- F01N 3/105 . . . { General auxiliary catalysts, e.g. upstream or downstream of the main catalyst}
- F01N 3/106 . . . . { Auxiliary oxidation catalysts}

F01N 3/108	....	{ Auxiliary reduction catalysts}
F01N 3/18	...	characterised by methods of operation; Regulation
F01N 3/20	....	specialy adapted for catalytic conversion; {Methods of operation or regulation of catalytic converters}(F01N 3/22 takes precedence)
F01N 3/2006	.....	{Periodically heating or cooling catalytic reactors, e.g. at cold starting or overheating (by electrically controlling the supply of combustible mixture or its constituents only F02D 41/0235)}
F01N 3/2013	.....	{using electric or magnetic heating means}
F01N 3/202	.....	{using microwaves}
F01N 3/2026	.....	{directly electrifying the catalyst substrate, i.e. heating the electrically conductive catalyst substrate by joule effect}
F01N 3/2033	.....	{using a fuel burner or introducing fuel into exhaust duct}
F01N 3/204	.....	{using an exhaust gas igniter, e.g. a spark or glow plug, without introducing fuel into exhaust duct}
F01N 3/2046	.....	{ Periodically cooling catalytic reactors}
F01N 3/2053	.....	{By-passing catalytic reactors, e.g. to prevent overheating}
F01N 3/206	.....	{ Adding periodically or continuously substances to exhaust gases for promoting purification, e.g. catalytic material in liquid form, NOx reducing agents (F01N 3/2066 takes precedence)}
F01N 3/2066	.....	{ Selective catalytic reduction (SCR)}

**WARNING**

[F01N 3/206](#) for documents published before March 2004.

F01N 3/2073	.....	{ with means for generating a reducing substance from the exhaust gases}
F01N 3/208	.....	{ Control of selective catalytic reduction (SCR), e.g. dosing of reducing agent}
F01N 3/2086	.....	{Activating the catalyst by light, photo-catalysts}
F01N 3/2093	.....	{ Periodically blowing a gas through the converter, e.g. in a direction opposite to exhaust gas flow or by reversing exhaust gas flow direction}
F01N 3/22	....	Regulation of additional air supply only, e.g. using by-passes or variable air pump drives
F01N 3/222	.....	[N: using electric valves only
F01N 3/225	.....	{ Electric control of additional air supply}
F01N 3/227	.....	{ using pneumatically operated valves, e.g. membrane valves}
F01N 3/24	...	characterised by constructional aspects of converting apparatus (filtering in combination with catalytic reactors <a href="#">F01N 3/035</a> )
F01N 3/26	....	Construction of thermal reactors
F01N 3/28	....	Construction of catalytic reactors
F01N 3/2803	.....	{characterised by structure, by material or by manufacturing of catalyst support}
F01N 3/2807	.....	{Metal other than sintered metal ( <a href="#">F01N 3/2832</a> and <a href="#">F01N 3/2835</a> take precedence)}
F01N 3/281	.....	{Metallic honeycomb monoliths made of stacked or rolled sheets, foils or plates}
F01N 3/2814	.....	{all sheets, plates or foils being corrugated}

F01N 3/2817	.....	{only with non-corrugated sheets, plates or foils}
F01N 3/2821	.....	{the support being provided with means to enhance the mixing process inside the converter, e.g. sheets, plates or foils with protrusions or projections to create turbulence}
F01N 3/2825	.....	{Ceramics ( <a href="#">F01N 3/2832</a> , <a href="#">F01N 3/2835</a> take precedence)}
F01N 3/2828	.....	{Ceramic multi-channel monoliths, e.g. honeycombs}
F01N 3/2832	.....	{granular, e.g. pellets}
F01N 3/2835	.....	{fibrous}
F01N 3/2839	.....	{Arrangements for mounting catalyst support in housing, e.g. with means for compensating thermal expansion or vibration}
F01N 3/2842	.....	{ specially adapted for monolithic supports, e.g. of honeycomb type ( <a href="#">F01N 3/2853</a> to <a href="#">F01N 3/2871</a> take precedence)}
F01N 3/2846	.....	{specially adapted for granular supports, e.g. pellets}
F01N 3/285	.....	{specially adapted for fibrous supports, e.g. held in place by screens}
F01N 3/2853	.....	{ using mats or gaskets between catalyst body or housing}
F01N 3/2857	.....	{ the mats or gaskets being at least partially made of intumescent material, e.g. unexpanded vermiculite}
F01N 3/286	.....	{ the mats or gaskets having corrugations or cavities}

**WARNING**

[F01N 3/2853](#) and [F01N 3/2857](#)

F01N 3/2864	.....	{ the mats or gaskets comprising two or more insulation layers}
F01N 3/2867	.....	{ the mats or gaskets being placed at the front or end face of catalyst body}

**WARNING**

[F01N 3/2853](#) and [F01N 3/2857](#)

F01N 3/2871	.....	{ the mats or gaskets having an additional, e.g. non-insulating or non-cushioning layer, a metal foil or an adhesive layer}
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**WARNING**

[F01N 3/2853](#) and [F01N 3/2857](#)

F01N 3/2875	.....	{ by using elastic means, e.g. spring leaves, for retaining catalyst body in the housing ( <a href="#">F01N 3/2853</a> to <a href="#">F01N 3/2871</a> take precedence)}
F01N 3/2878	.....	{ by using non-elastic means for retaining catalyst body in the housing, e.g. a metal chamfer, or by corrugation or deformation of the metal housing}
F01N 3/2882	.....	{Catalytic reactors combined or associated with other devices, e.g. exhaust silencers or other exhaust purification devices (combined with absorbents or adsorbents only <a href="#">F01N 3/0814</a> ; combined with particulate filters <a href="#">F01N 3/035</a> )}
F01N 3/2885	.....	{with exhaust silencers in a single housing}
F01N 3/2889	.....	{with heat exchangers in a single housing}
F01N 3/2892	.....	{Exhaust flow directors or the like, e.g. upstream of catalytic device}

- F01N 3/2896 . . . . . { Liquid catalyst carrier}
- F01N 3/30 . . . . . Arrangements for supply of additional air (regulation, e.g. using air by-passes or variable air pump drives [F01N 3/22](#))
- F01N 3/303 . . . . . { Filtering additional air}
- F01N 3/306 . . . . . { Preheating additional air}
- F01N 3/32 . . . . . using air pump (using jet air pumps [F01N 3/34](#); pumps in general [F04](#))
- F01N 3/323 . . . . . { Electrically driven air pumps}
- F01N 3/326 . . . . . { Engine-driven air pumps}
- F01N 3/34 . . . . . using air conduits or jet air pumps, e.g. near the engine exhaust port
- F01N 3/36 . . . . . Arrangements for supply of additional fuel
- F01N 3/38 . . . . . Arrangements for igniting

**F01N 5/00** **Exhaust or silencing apparatus combined or associated with devices profiting by exhaust energy** (predominant aspects of such devices, see the relevant classes for the devices; using kinetic or wave energy of exhaust gases in exhaust systems for charging [F02B](#))

**NOTE**

- in this group the following indexing code is used: [F02M 2700/31](#)

- F01N 5/02 . the devices using heat
- F01N 5/025 . . { the device being thermoelectric generators}

**WARNING**

[F01N 5/02](#)

- F01N 5/04 . the devices using kinetic energy

**F01N 9/00** **Electrical control of exhaust gas treating apparatus** (monitoring or diagnostic devices for exhaust-gas treatment apparatus [F01N 11/00](#); {electrical control of supply of combustible mixture or its constituents in relation with the state of the exhaust gas treating apparatus [F02D 41/0235](#)}; controlling combustion engines conjoint electrical control of two or more combustion engine functions [F02D 43/00](#))

- F01N 9/002 . {of filter regeneration, e.g. detection of clogging}
- F01N 9/005 . { using models instead of sensors to determine operating characteristics of exhaust systems, e.g. calculating catalyst temperature instead of measuring it directly}
- F01N 9/007 . { Storing data relevant to operation of exhaust systems for later retrieval and analysis, e.g. to research exhaust system malfunctions}

**F01N 11/00** **Monitoring or diagnostic devices for exhaust-gas treatment apparatus**, {e.g. for catalytic activity (safety, indicating or supervising devices for internal combustion engines [F02B 77/08](#); testing of machines [G01M 13/00](#))}

- F01N 11/002 . {the diagnostic devices measuring or estimating temperature or pressure in, or downstream of the exhaust apparatus}
- F01N 11/005 . . {the temperature or pressure being estimated, e.g. by means of a theoretical model}
- F01N 11/007 . {the diagnostic devices measuring oxygen or air concentration downstream of the exhaust apparatus}
  
- F01N 13/00** **Exhaust or silencing apparatus characterised by constructional features;** { Exhaust or silencing apparatus, or parts thereof, having pertinent characteristics not provided for in, or of interest apart from, groups [F01N 1/00](#) to [F01N 5/00](#), [F01N 9/00](#), [F01N 11/00](#)}
  
- F01N 13/001 . { Gas flow channels or gas chambers being at least partly formed in the structural parts of the engine or machine (using structural parts of the vehicle [B60K 13/06](#))}
- F01N 13/002 . { Apparatus adapted for particular uses, e.g. for portable devices driven by machines or engines}
- F01N 13/004 . { specially adapted for marine propulsion, i.e. for receiving simultaneously engine exhaust gases and engine cooling water (for submerged exhausting [F01N 13/12](#); treating exhaust by using liquids [F01N 3/04](#))}
- F01N 13/005 . . { with parts constructed of non-metallic material, e.g. of rubber}
- F01N 13/007 . { Apparatus used as intake or exhaust silencer (silencing methods [F01N 1/00](#); intake silencers [F02M 35/12](#))}
- F01N 13/008 . { Mounting or arrangement of exhaust sensors in or on exhaust apparatus (sensor arrangements for engine control [F02D 41/1439](#))}
- F01N 13/02 . having two or more separate silencers in series
- F01N 13/04 . having two or more silencers in parallel e.g. having interconnections for multi-cylinder engines
- F01N 13/06 . specially adapted for star-arrangement of cylinders, e.g. exhaust manifolds
- F01N 13/08 . Other arrangements or adaptations of exhaust conduits ({ pipes, joints or supports therefor in general [F16L](#); collecting or removing exhaust gases of vehicle engines in workshops [B08B 15/00](#), on highways [E01C 1/005](#))}
- F01N 13/082 . . { of tailpipe, e.g. with means for mixing air with exhaust for exhaust cooling, dilution or evacuation ([F01N 13/20](#) takes precedence)}
- F01N 13/085 . . { having means preventing foreign matter from entering exhaust conduit}
- F01N 13/087 . . { having valves upstream of silencing apparatus for by-passing at least part of exhaust directly to atmosphere (valves for changing gas flow path through the silencer [F01N 1/166](#))}
- F01N 13/10 . . of exhaust manifolds {(with cooling jacket [F01N 3/046](#))}
- F01N 13/102 . . . { having thermal insulation}
- F01N 13/105 . . . { having the form of a chamber directly connected to the cylinder head, e.g. without having tubes connected between cylinder head and chamber}

- F01N 13/107 . . . { More than one exhaust manifold or exhaust collector}
- F01N 13/12 . specially adapted for submerged exhausting
- F01N 13/14 . having thermal insulation {(exhaust manifolds [F01N 13/102](#))}
- F01N 13/141 . . { Double-walled exhaust pipes or housings}
- F01N 13/143 . . . { with air filling the space between both walls}
- F01N 13/145 . . . { with gas other than air filling the space between both walls}
- F01N 13/146 . . . { with vacuum in the space between both walls}
- F01N 13/148 . . { Multiple layers of insulating material}
- F01N 13/16 . Selection of particular materials
- F01N 13/18 . Construction facilitating manufacture, assembly, or disassembly
- F01N 13/1805 . . { Fixing exhaust manifolds, exhaust pipes or pipe sections to each other, to engine or to vehicle body (pipe joints in general [F16L](#); fixing auxiliaries in motor vehicles in general [B60K](#))}
- F01N 13/1811 . . . { with means permitting relative movement, e.g. compensation of thermal expansion or vibration}
- F01N 13/1816 . . . . { the pipe sections being joined together by flexible tubular elements only, e.g. using bellows or strip-wound pipes}
- F01N 13/1822 . . . . { for fixing exhaust pipes or devices to vehicle body}
- F01N 13/1827 . . . { Sealings specially adapted for exhaust systems (sealings in general [F16J 15/00](#))}
- F01N 13/1833 . . { specially adapted for small internal combustion engines, e.g. used in model applications}
- F01N 13/1838 . . { characterised by the type of connection between parts of exhaust or silencing apparatus, e.g. between housing and tubes, between tubes and baffles}
- F01N 13/1844 . . . { Mechanical joints}
- F01N 13/185 . . . . { the connection being realised by deforming housing, tube, baffle, plate, or parts thereof}
- F01N 13/1855 . . . . { the connection being realised by using bolts, screws, rivets or the like}
- F01N 13/1861 . . { the assembly using parts formed by casting or moulding}
- F01N 13/1866 . . . { the channels or tubes thereof being made integrally with the housing}
- F01N 13/1872 . . { the assembly using stamp-formed parts or otherwise deformed sheet-metal}
- F01N 13/1877 . . . { the channels or tubes thereof being made integrally with the housing}
- F01N 13/1883 . . { manufactured by hydroforming}
- F01N 13/1888 . . { the housing of the assembly consisting of two or more parts, e.g. two half-shells}
- F01N 13/1894 . . . { the parts being assembled in longitudinal direction}
- F01N 13/20 . having flared outlets, e.g. of fish-tail shape
- F01N 2013/00 Exhaust or silencing apparatus characterised by constructional features; { Exhaust or silencing apparatus, or parts thereof, having pertinent characteristics not provided for in, or of interest apart from, groups [F01N 1/00](#) to [F01N 5/00](#), [F01N 9/00](#), [F01N 11/00](#)}**

- F01N 2013/02 . having two or more separate silencers in series
- F01N 2013/023 . . with two or more of the same type of purifying devices in series
- F01N 2013/026 . . in a single housing
- F01N 2013/04 . having two or more silencers in parallel e.g. having interconnections for multi-cylinder engines
- F01N 2013/045 . . in a single housing

#### **F01N 2210/00**      **Combination of methods of silencing**

- F01N 2210/02 . Resonance and interference
- F01N 2210/04 . Throttling-expansion and resonance
- F01N 2210/06 . Throttling-expansion and interference

#### **F01N 2230/00**      **Combination of silencers and other devices**

- F01N 2230/02 . Exhaust filters
- F01N 2230/04 . Catalytic converters
- F01N 2230/06 . Spark arresters
- F01N 2230/08 . Thermal reactors

#### **F01N 2240/00**      **Combination or association of two or more different exhaust treating devices, or of at least one such device with an auxiliary device, not covered by indexing codes [F01N 2230/00](#) or [F01N 2250/00](#), one of the devices being**

- F01N 2240/02 . a heat exchanger
- F01N 2240/04 . an electric, e.g. electrostatic, device other than a heater
- F01N 2240/05 . a magnetic, e.g. electromagnetic, device other than a valve
- F01N 2240/06 . an inertial, e.g. centrifugal, device
- F01N 2240/10 . a heat accumulator
- F01N 2240/12 . a thermal reactor
- F01N 2240/14 . a fuel burner

- F01N 2240/16 . an electric heater, i.e. a resistance heater
- F01N 2240/18 . an adsorber or absorber
- F01N 2240/20 . a flow director or deflector
- F01N 2240/22 . a condensation chamber
- F01N 2240/25 . an ammonia generator
- F01N 2240/26 . an exhaust gas reservoir, e.g. emission buffer
- F01N 2240/28 . a plasma reactor
- F01N 2240/30 . a fuel reformer
- F01N 2240/32 . a fuel cell
- F01N 2240/34 . an electrolyser
- F01N 2240/36 . an exhaust flap
- F01N 2240/38 . an ozone (O<sub>3</sub>) generator, e.g. for adding ozone after generation of ozone from air
- F01N 2240/40 . a hydrolysis catalyst

**F01N 2250/00 Combinations of different methods of purification**

- F01N 2250/02 . filtering and catalytic conversion
- F01N 2250/04 . afterburning and catalytic conversion
- F01N 2250/06 . afterburning and filtering
- F01N 2250/08 . filtering and inertial particulate separation
- F01N 2250/10 . cooling and filtering
- F01N 2250/12 . absorption or adsorption, and catalytic conversion
- F01N 2250/14 . absorption or adsorption, and filtering

**F01N 2260/00 Exhaust treating devices having provisions not otherwise provided for**

- F01N 2260/02 . for cooling the device
- F01N 2260/022 .. using air
- F01N 2260/024 .. using a liquid
- F01N 2260/04 . for regeneration or reactivation, e.g. of catalyst

- F01N 2260/06 . for improving exhaust evacuation or circulation, or reducing back-pressure
- F01N 2260/08 . for preventing heat loss or temperature drop, using other means than layers of heat-insulating material
- F01N 2260/10 . for avoiding stress caused by expansions or contractions due to temperature variations
- F01N 2260/12 . for resisting high pressure
- F01N 2260/14 . for modifying or adapting flow area or back-pressure
- F01N 2260/16 . for reducing exhaust flow pulsations
- F01N 2260/18 . for improving rigidity, e.g. by wings, ribs
- F01N 2260/20 . for heat or sound protection, e.g. using a shield or specially shaped outer surface of exhaust device
- F01N 2260/22 . for preventing theft of exhaust parts or devices, e.g. anti-theft arrangements
- F01N 2260/24 . for identifying exhaust parts or devices, e.g. by labels, stickers or directly printing
- F01N 2260/26 . for preventing enter of dirt into the device
  
- F01N 2270/00      **Mixing air with exhaust gases****
- F01N 2270/02 . for cooling exhaust gases or the apparatus
- F01N 2270/04 . for afterburning
- F01N 2270/06 . for silencing
- F01N 2270/08 . for evacuation of exhaust gases, e.g. in tail-pipes
- F01N 2270/10 . for rendering exhaust innocuous, e.g. by dilution
  
- F01N 2290/00      **Movable parts or members in exhaust systems for other than for control purposes****
- F01N 2290/02 . with continuous rotary movement
- F01N 2290/04 . . driven by exhaust gases
- F01N 2290/06 . . driven by auxiliary drive
- F01N 2290/08 . with oscillating or vibrating movement
- F01N 2290/10 . . actuated by pressure of exhaust gases, e.g. exhaust pulses
  
- F01N 2310/00      **Selection of sound absorbing or insulating material****

- F01N 2310/02 . Mineral wool, e.g. glass wool, rock wool, asbestos or the like
- F01N 2310/04 . Metallic wool, e.g. steel wool, copper wool or the like
- F01N 2310/06 . Porous ceramics
- F01N 2310/08 . Exfoliated vermiculite, e.g. zonolite, coke, pumice
- F01N 2310/10 . Plastic foam
- F01N 2310/12 . Granular material
- F01N 2310/14 . Wire mesh fabric, woven glass cloth or the like

**F01N 2330/00      Structure of catalyst support or particle filter**

- F01N 2330/02 . Metallic plates or honeycombs, e.g. superposed or rolled-up corrugated or otherwise deformed sheet metal
- F01N 2330/04 . . . Methods of manufacturing
- F01N 2330/06 . Ceramic, e.g. monoliths
- F01N 2330/08 . Granular material
- F01N 2330/10 . Fibrous material, e.g. mineral or metallic wool
- F01N 2330/101 . . . using binders, e.g. to form a permeable mat, paper or the like
- F01N 2330/102 . . . . fibrous material being fiber reinforced polymer made of plastic matrix reinforced by fine glass or in the form of a loose mass of filaments or fibers
- F01N 2330/12 . Metallic wire mesh fabric or knitting
- F01N 2330/14 . Sintered material
- F01N 2330/18 . Composite material
- F01N 2330/20 . Plastics, e.g. polymers, polyester, polyurethane
- F01N 2330/22 . Metal foam
- F01N 2330/30 . Honeycomb supports characterised by their structural details
- F01N 2330/32 . . . characterised by the shape, form or number of corrugations of plates, sheets or foils
- F01N 2330/321 . . . . with two or more different kinds of corrugations in the same substrate
- F01N 2330/322 . . . . Corrugations of trapezoidal form
- F01N 2330/323 . . . . Corrugations of saw-tooth or triangular form
- F01N 2330/324 . . . . Corrugations of rectangular form
- F01N 2330/325 . . . . Corrugations of omega form
- F01N 2330/34 . . . with flow channels of polygonal cross section

- F01N 2330/36 . . with flow channels formed by tubes
- F01N 2330/38 . . flow channels with means to enhance flow mixing, (e.g. protrusions or projections)
- F01N 2330/40 . . made of a single sheet, foil or plate
- F01N 2330/42 . . made of three or more different sheets, foils or plates stacked one on the other
- F01N 2330/44 . . made of stacks of sheets, plates or foils that are folded in S-form
- F01N 2330/48 . . characterised by the number of flow passages, e.g. cell density
  
- F01N 2330/60 . Discontinuous, uneven properties of filter material, e.g. different material thickness along the longitudinal direction; Higher filter capacity upstream than downstream in same housing
  
- F01N 2340/00**      **Dimensional characteristics of the exhaust system, e.g. length, diameter or volume of the apparatus; Spatial arrangements of exhaust apparatuses**
  
- F01N 2340/02 . characterised by the distance of the apparatus to the engine, or the distance between two exhaust treating apparatuses
  
- F01N 2340/04 . characterised by the arrangement of an exhaust pipe, manifold or apparatus in relation to vehicle frame or particular vehicle parts
  
- F01N 2340/06 . characterised by the arrangement of the exhaust apparatus relative to the turbine of a turbocharger
  
- F01N 2350/00**      **Arrangements for fitting catalyst support or particle filter element in the housing**
  
- F01N 2350/02 . Fitting ceramic monoliths in a metallic housing
- F01N 2350/04 . . with means compensating thermal expansion
- F01N 2350/06 . . with means preventing gas flow by-pass or leakage
  
- F01N 2350/08 . with means for compressing granular material
  
- F01N 2370/00**      **Selection of materials for exhaust purification**
  
- F01N 2370/02 . used in catalytic reactors
- F01N 2370/04 . . Zeolitic material
  
- F01N 2370/22 . used in non-catalytic purification apparatus
- F01N 2370/24 . . Zeolitic material
- F01N 2370/30 . . Materials having magnetic properties
  
- F01N 2370/40 . Activated carbon or charcoal
  
- F01N 2390/00**      **Arrangements for controlling or regulating exhaust apparatus**
  
- F01N 2390/02 . using electric components only
  
- F01N 2390/04 . using electropneumatic components

- F01N 2390/06 . using pneumatic components only
- F01N 2390/08 . using mechanical components only, e.g. actuated manually
- F01N 2410/00      **By-passing, at least partially, exhaust from inlet to outlet of apparatus, to atmosphere or to other device****
- F01N 2410/02 . in case of high temperature, e.g. overheating of catalytic reactor
- F01N 2410/03 . in case of low temperature
- F01N 2410/04 . during regeneration period, e.g. of particle filter
- F01N 2410/06 . at cold starting
- F01N 2410/08 . in case of clogging, e.g. of particle filter
- F01N 2410/10 . for reducing flow resistance, e.g. to obtain more engine power
- F01N 2410/12 . in case of absorption, adsorption or desorption of exhaust gas constituents
- F01N 2410/14 . in case of excessive pressure, e.g. using a safety valve
- F01N 2430/00      **Influencing exhaust purification, e.g. starting of catalytic reaction, filter regeneration, or the like, by controlling engine operating characteristics****
- F01N 2430/02 . by cutting out a part of engine cylinders
- F01N 2430/04 . by adding non-fuel substances to combustion air or fuel, e.g. additives
- F01N 2430/06 . by varying fuel-air ratio, e.g. by enriching fuel-air mixture
- F01N 2430/08 . by modifying ignition or injection timing
- F01N 2430/085 . . at least a part of the injection taking place during expansion or exhaust stroke
- F01N 2430/10 . by modifying inlet or exhaust valve timing
- F01N 2450/00      **Methods or apparatus for fitting, inserting or repairing different elements****
- F01N 2450/02 . Fitting monolithic blocks into the housing
- F01N 2450/04 . Filling or emptying a chamber with granular material
- F01N 2450/06 . Inserting sound absorbing material into a chamber
- F01N 2450/08 . Repairing the housing or pipe-joints
- F01N 2450/10 . Fitting temporarily exhaust apparatus on exhaust conduit, e.g. in confined environment, garage or the like

- F01N 2450/16 . by using threaded joints
- F01N 2450/18 . by using quick-active type locking mechanisms, e.g. clips
- F01N 2450/20 . by mechanical joints, e.g. by deforming housing, tube, baffle plate or parts thereof
- F01N 2450/22 . by welding or brazing
- F01N 2450/24 . by bolts, screws, rivets or the like
- F01N 2450/26 . by bayonet fittings
- F01N 2450/28 . by using adhesive material, e.g. cement
- F01N 2450/30 . Removable or rechargeable blocks or cartridges, e.g. for filters
- F01N 2450/40 . Retrofitting exhaust apparatus
  
- F01N 2470/00      **Structure or shape of gas passages, pipes or tubes****
  
- F01N 2470/02 . Tubes being perforated
- F01N 2470/04 . . characterised by shape, disposition or dimensions of apertures
  
- F01N 2470/06 . Tubes being formed by assembly of stamped or otherwise deformed sheet-metal
  
- F01N 2470/08 . Gas passages being formed between the walls of an outer shell and an inner chamber
  
- F01N 2470/10 . Tubes having non-circular cross section
  
- F01N 2470/12 . Tubes being corrugated
  
- F01N 2470/14 . Plurality of outlet tubes, e.g. in parallel or with different length
  
- F01N 2470/16 . Plurality of inlet tubes, e.g. discharging into different chambers
  
- F01N 2470/18 . the axis of inlet or outlet tubes being other than the longitudinal axis of apparatus
  
- F01N 2470/20 . Dimensional characteristics of tubes, e.g. length, diameter
  
- F01N 2470/22 . Inlet and outlet tubes being positioned on the same side of the apparatus
  
- F01N 2470/24 . Concentric tubes or tubes being concentric to housing, e.g. telescopically assembled
  
- F01N 2470/26 . Tubes being formed by extrusion, drawing or rolling
  
- F01N 2470/28 . Tubes being formed by moulding or casting x
  
- F01N 2470/30 . Tubes with restrictions, i.e. venturi or the like, e.g. for sucking air or measuring mass flow

**F01N 2490/00****Structure, disposition or shape of gas-chambers**

- F01N 2490/02 . Two or more expansion chambers in series connected by means of tubes
- F01N 2490/04 . . the gases flowing longitudinally from inlet to outlet only in one direction
- F01N 2490/06 . . the gases flowing longitudinally from inlet to outlet in opposite directions
- F01N 2490/08 . Two or more expansion chambers in series separated by apertured walls only
- F01N 2490/10 . Two or more expansion chambers in parallel
- F01N 2490/12 . Chambers having variable volumes
- F01N 2490/14 . Dead or resonance chambers connected to gas flow tube by relatively short side-tubes
- F01N 2490/15 . Plurality of resonance or dead chambers
- F01N 2490/155 . . being disposed one after the other in flow direction
- F01N 2490/16 . Chambers with particular shapes, e.g. spherical
- F01N 2490/18 . Dimensional characteristics of gas chambers
- F01N 2490/20 . Chambers being formed inside the exhaust pipe without enlargement of the cross section of the pipe, e.g. resonance chambers

**F01N 2510/00****Surface coverings**

- F01N 2510/02 . for thermal insulation
- F01N 2510/04 . for sound absorption
- F01N 2510/06 . for exhaust purification, e.g. catalytic reaction
- F01N 2510/061 . . usable with leaded fuels
- F01N 2510/063 . . zeolites
- F01N 2510/065 . . for reducing soot ignition temperature
- F01N 2510/067 . . usable with sulfurised fuels
- F01N 2510/068 . . characterised by the distribution of the catalytic coatings
- F01N 2510/0682 . . . having a discontinuous, uneven or partially overlapping coating of catalytic material, e.g. higher amount of material upstream than downstream or vice-versa
- F01N 2510/0684 . . . having more than one coating layer, e.g. multi-layered coatings
- F01N 2510/08 . for corrosion prevention
- F01N 2510/10 . for preventing carbon deposits, e.g. chromium
- F01N 2510/12 . for smell removal

F01N 2510/14 . for dehydrating

**F01N 2530/00 Selection of materials for tubes, chambers or housings**

F01N 2530/02 . Corrosion resistive metals

F01N 2530/04 . . Steel alloys, e.g. stainless steel

F01N 2530/06 . Aluminium or alloys thereof

F01N 2530/18 . Plastics material, e.g. polyester resin

F01N 2530/20 . . reinforced with mineral or metallic fibres

F01N 2530/22 . Flexible elastomeric material

F01N 2530/24 . Sintered porous material, e.g. bronze, aluminium or the like

F01N 2530/26 . Multi-layered walls

**F01N 2550/00 Monitoring or diagnosing the deterioration of exhaust systems**

F01N 2550/02 . Catalytic activity of catalytic converters

F01N 2550/03 . of sorbing activity of adsorbents or absorbents

F01N 2550/04 . Filtering activity of particulate filters

F01N 2550/05 . Systems for adding substances into exhaust

F01N 2550/06 . By-pass systems

F01N 2550/10 . . of catalytic converters

F01N 2550/12 . . of particulate filters

F01N 2550/14 . Systems for adding secondary air into exhaust

F01N 2550/20 . Monitoring artificially aged exhaust systems

F01N 2550/22 . of electric heaters for exhaust systems or their power supply

F01N 2550/24 . Determining the presence or absence of an exhaust treating device

**F01N 2560/00 Exhaust systems with means for detecting or measuring exhaust gas components or characteristics**

F01N 2560/02 . the means being an exhaust gas sensor

F01N 2560/021 . . for measuring or detecting ammonia NH<sub>3</sub>

F01N 2560/022 . . for measuring or detecting CO or CO<sub>2</sub>

F01N 2560/023 . . for measuring or detecting HC

- F01N 2560/024 . . for measuring or detecting hydrogen H<sub>2</sub>
- F01N 2560/025 . . for measuring or detecting O<sub>2</sub>, e.g. lambda sensors
- F01N 2560/026 . . for measuring or detecting NO<sub>x</sub>
- F01N 2560/027 . . for measuring or detecting SO<sub>x</sub>
- F01N 2560/028 . . for measuring or detecting humidity or water
  
- F01N 2560/05 . the means being a particulate sensor
- F01N 2560/06 . the means being a temperature sensor
- F01N 2560/07 . the means being an exhaust gas flow rate or velocity meter or sensor, intake flow meters only when exclusively used to determine exhaust gas parameters
- F01N 2560/08 . the means being a pressure sensor
- F01N 2560/12 . Other sensor principles, e.g. using electro conductivity of substrate or radio frequency
- F01N 2560/14 . having more than one sensor of one kind
- F01N 2560/20 . Sensor having heating means
  
- F01N 2570/00 Exhaust treating apparatus eliminating, absorbing or adsorbing specific elements or compounds**
  
- F01N 2570/02 . Lead
- F01N 2570/04 . Sulfur or sulfur oxides
- F01N 2570/06 . Zinc
- F01N 2570/08 . Phosphorus
- F01N 2570/10 . Carbon or carbon oxides
- F01N 2570/12 . Hydrocarbons
- F01N 2570/14 . Nitrogen oxides
- F01N 2570/145 . . Dinitrogen oxide
- F01N 2570/16 . Oxygen
- F01N 2570/18 . Ammonia
- F01N 2570/20 . Formaldehyde
- F01N 2570/22 . Water or humidity
- F01N 2570/24 . Hydrogen sulfide (H<sub>2</sub>S)

**F01N 2590/00 Exhaust or silencing apparatus adapted to particular use, e.g. for military applications, airplanes, submarines**

- F01N 2590/02 . for marine vessels or naval applications
- F01N 2590/021 . . for outboard engines
- F01N 2590/022 . . for jetskis
- F01N 2590/04 . for motorcycles
- F01N 2590/06 . for hand-held tools or portables devices
- F01N 2590/08 . for heavy duty applications, e.g. trucks, buses, tractors, locomotives
- F01N 2590/10 . for stationary applications
- F01N 2590/11 . for hybrid vehicles

**F01N 2610/00 Adding substances to exhaust gases**

- F01N 2610/01 . the substance being catalytic material in liquid form
- F01N 2610/02 . the substance being ammonia or urea
- F01N 2610/03 . the substance being hydrocarbons, e.g. engine fuel
- F01N 2610/04 . the substance being hydrogen
- F01N 2610/05 . the substance being carbon monoxide
- F01N 2610/06 . the substance being in the gaseous form
- F01N 2610/08 . with prior mixing of the substances with a gas, e.g. air
- F01N 2610/085 . . Controlling the air supply
- F01N 2610/10 . the substance being heated, e.g. by heating tank or supply line of the added substance
- F01N 2610/102 . . after addition to exhaust gases, e.g. by a passively or actively heated surface in the exhaust conduit
- F01N 2610/105 . . Control thereof
- F01N 2610/107 . . using glow plug heating elements
- F01N 2610/11 . the substance or part of the dosing system being cooled
- F01N 2610/12 . the substance being in solid form, e.g. pellets or powder
- F01N 2610/14 . Arrangements for the supply of substances, e.g. conduits
- F01N 2610/1406 . . Storage means for substances, e.g. tanks or reservoirs
- F01N 2610/1413 . . . Inlet and filling arrangements therefore

- F01N 2610/142 . . . Controlling the filling of the tank
- F01N 2610/1426 . . . Filtration means
- F01N 2610/1433 . . . Pumps
- F01N 2610/144 . . . Control thereof
- F01N 2610/1446 . . . Means for damping of pressure fluctuations in the delivery system, e.g. by puffer volumes or throttling
- F01N 2610/1453 . . . Sprayers or atomisers; Arrangement thereof in the exhaust apparatus
- F01N 2610/146 . . . Control thereof, e.g. control of injectors or injection valves
- F01N 2610/1466 . . . Means for venting air out of conduits or tanks
- F01N 2610/1473 . . . Overflow or return means for the substances, e.g. conduits or valves for the return path
- F01N 2610/148 . . . Arrangement of sensors
- F01N 2610/1486 . . . Means to prevent the substance from freezing
- F01N 2610/1493 . . . Means for prevention of purging or clogging

#### **F01N 2900/00 Details of electrical control or of the monitoring of the exhaust gas treating apparatus**

- F01N 2900/04 . . Methods of control or diagnosing
  - F01N 2900/0402 . . . using adaptive learning
  - F01N 2900/0404 . . . using a data filter
  - F01N 2900/0406 . . . using a model with a division of the catalyst or filter in several cells
  - F01N 2900/0408 . . . using a feed-back loop
  - F01N 2900/0411 . . . using a feed-forward control
  - F01N 2900/0412 . . . using pre-calibrated maps, tables or charts
  - F01N 2900/0414 . . . using a state observer
  - F01N 2900/0416 . . . using the state of a sensor, e.g. of an exhaust gas sensor
  - F01N 2900/0418 . . . using integration or an accumulated value within an elapsed period
  - F01N 2900/0421 . . . using an increment counter when a predetermined event occurs
  - F01N 2900/0422 . . . measuring the elapsed time
- F01N 2900/06 . . Parameters used for exhaust control or diagnosing
  - F01N 2900/0601 . . . being estimated
  - F01N 2900/0602 . . . Electrical exhaust heater signals
  - F01N 2900/08 . . . said parameters being related to the engine
  - F01N 2900/10 . . . said parameters being related to the vehicle or its components
    - F01N 2900/102 . . . Travelling distance
    - F01N 2900/104 . . . Battery status
  - F01N 2900/12 . . . said parameters being related to the vehicle exterior
  - F01N 2900/14 . . . said parameters being related to the exhaust gas
    - F01N 2900/1402 . . . Exhaust gas composition
    - F01N 2900/1404 . . . Exhaust gas temperature

F01N 2900/1406	...	Exhaust gas pressure
F01N 2900/1411	...	Exhaust gas velocity
F01N 2900/16	..	said parameters being related to the exhaust apparatus, e.g. particulate filter or catalyst
F01N 2900/1602	...	Temperature of exhaust gas apparatus
F01N 2900/1606	...	Particle filter loading or soot amount
F01N 2900/1611	...	Particle filter ash amount
F01N 2900/1612	...	SOx amount trapped in catalyst
F01N 2900/1614	...	NOx amount trapped in catalyst
F01N 2900/1616	...	NH3-slip from catalyst
F01N 2900/1618	...	HC-slip from catalyst
F01N 2900/1621	...	Catalyst conversion efficiency
F01N 2900/1622	...	Catalyst reducing agent absorption capacity or consumption amount
F01N 2900/1624	...	Catalyst oxygen storage capacity
F01N 2900/1626	...	Catalyst activation temperature
F01N 2900/1628	...	Moisture amount in exhaust apparatus
F01N 2900/1631	...	Heat amount provided to exhaust apparatus
F01N 2900/18	..	said parameters being related to the system for adding a substance into the exhaust
F01N 2900/1804	...	Properties of secondary air added directly to the exhaust
F01N 2900/1806	...	Properties of reducing agent or dosing system
F01N 2900/1808	....	Pressure
F01N 2900/1811	....	Temperature
F01N 2900/1812	....	Flow rate
F01N 2900/1814	....	Tank level
F01N 2900/1818	....	Concentration of the reducing agent
F01N 2900/1821	....	Injector parameters
F01N 2900/1822	....	Pump parameters
F01N 2900/1824	....	Properties of the air to be mixed with added substances, e.g. air pressure or air temperature